

REMARKS/ARGUMENTS

In the Office action dated June 29, 2005, the Examiner continued to assert that the Abstract of the Disclosure is written in “legal” language, however, the Examiner failed to specifically identify such “legal” language. Applicant has amended the Abstract in the hopes of overcoming the Examiner’s objection, and continues to assert that the Abstract, as originally filed, fully complies with the requirements of the USPTO, and is presented in perfectly acceptable, Standard American English narrative form.

The Examiner included a paragraph regarding Applicant’s arguments to the claims as amended in response to the previous Office action - which is what Applicant was intending to do. In the course of a telephone interview with Examiner Thompson on September 13, 2005, the Examiner stated that this paragraph was a “form” paragraph and acknowledged that another sentence, to the effect that these matters would be discussed in the “Rejection” section of the Office action should have been included.

In the Specification, None

In the Claims, claims 1 and 8 have been amended; new claims 13-17 have been added. No Additional Fees are required.

In the Abstract, the Abstract has been amended.

The Invention

The provides a method of screening, in color reproduction systems, to render second generation halftone images through a multi-level halftone technique. *It should be understood that the method of the invention is not a de-screening process:* the method of the

invention preserves the original halftone dots and pixels therein, which is why the method of the invention is able, efficiently, to generate a second generation halftone image without the generation of interference lines, or moiré.

Under known, prior art methods, it is difficult to render halftone images using a second halftone process, because two halftones interfere, causing a distortion, in the form of a low frequency binary banding pattern, called moiré, which appears as alternating light and dark bands, or patches, in the second generation halftone image.

The normal procedure to reduce or eliminate this moiré is by applying a low pass filter to the original halftone image, thus smoothing or eliminating the binary pattern. The application of such low pass filters smooths or eliminates the original halftone pattern, which is essentially an averaging process over the entire halftone pattern. The filtering process causes blurred edges and loss of fine details. This additional process considerably slows the rendering process. Some improvements to the filtering process attempt to preserve sharp edges, however, these improvements only help to preserve hard, distinct edges and do nothing to preserve fine details.

The method of the invention uses a multi-level screening process to preserve the original halftone structure, without introducing distortion, or moiré, into a resultant, second generation halftone image. The method of the invention does not destroy or blur the halftone pattern: it preserves the original halftone dots by using multi-level tone reproduction. This method renders the original halftone image without introducing any interference pattern, or moiré, from the second screen pattern, which normally interferes with the original screen pattern.

In the method of the invention, multi-level halftoning provides a “soft screening”, that *averages the scanning noises* without reconstructing new halftone centers and without averaging the image components, as it does in a low-pass filter, or de-screening, process. The steps of the method of the invention are as follows:

1. **Determine the number of tone levels required in a pixel.** A continuous tone image pixel requires 256 graylevels to provide an accurate representation, however, a halftone image pixel does not require the full 256 graylevels. If, however, there are not enough graylevels, the original halftone dots will not be accurately reproduced.
2. **Select a halftone cell size.** For example, for 4-bit halftoning, each pixel may display 15 levels of gray; therefore, an NxN sized halftone cell is able to display K amount of graylevels, where $K = N \times N \times 15$. For good printing quality, a halftone dot should be able to display 255 graylevels, at least be able to display a number of graylevels close to 255. The original dot density is preserved by applying a multi-step threshold during scanning.
3. **Arrange the dot growth pattern.** If the dot growth pattern begins in the center of the halftone cell, a screen pattern will be visible. If any periodic dot centers can be visually sensed, the screen pattern will also be visible. The method of the invention provides a technique for avoiding the dot centers by growing the halftone dots evenly over the entire halftone cell. “Evenly” means that, in a tint area for any input graylevel, the maximum sub-pixel level difference among all pixels is “1”.

The method of the invention uses a very fine grid, which is a repeatable pattern, which follows the original halftone structure. The input signal is used with several levels of

thresholding, *i.e.*, the halftoned image is processed using multilevel thresholding, however, because no secondary pattern is applied to the original signal, no moiré is produced.

The Applied Art

U. S. Patent No. 6,172,769 B1 to Rao *et al.*, describes a de-screening process, which, as described above, and in the Background portion of the Specification, is an averaging process, which results in distortion to the second generation halftone. The reference is a single-level process. A secondary signal is applied to the original signal, which results in the objectionable moiré.

U. S. Patent No. 5,777,757 to Karlsson *et al.* describes a multi-level process, however, the process generates a halftone from an original image, not from an already halftoned image.

U. S. Patent No. 6,643,032 B1, granted November 4, 2003 to Crean *et al.*, like '757, describes techniques for generating a halftone image from an original, non-halftoned image.

The Examiner proposed combinations of the applied art does not suggest the method of the invention because a halftoned image, once de-screened by the method of Rao *et al.* requires more treatment before the application of Karlsson *et al.*'s or Crean *et al.*'s methods, otherwise, the moiré will appear.

The Claims

Claim 1 has been amended to incorporate the limitations of:

*...selecting an image which has been halftoned by forming original halftone dots, wherein each halftone dot includes at least one pixel therefor;...
scanning the selected halftoned image to produce a second generation halftoned image, which retains the original halftone dots and pixels therein;....*

These limitation are described in the Specification, beginning on page 7. As previously noted, the applied art averages the halftoned image, which results in blurring and the generation of moiré. The method of the invention averages the noise created during scanning, which retains the original characteristics of the halftoned image, and does not produce moiré, by keeping the structure of the originally formed halftone dots and pixels.

Roa *et al.* describe a conventional de-screening process, which will result in the generation of moiré. '769 does, however, describe the selection of an image, as does '032. Neither '769 nor '032 describes keeping the original structure of dots and pixels: '796 averages dots and pixels; '032 does not have original dots and pixels to begin with, so the Examiner suggested combination of '769 and '032 cannot possibly render Applicant's claim invention obvious. In light of the foregoing, claim 1 is allowable over the prior art of record.

Claims 2-5 are allowable with their allowable parent claim(s).

Claim 6 recites that number of tone levels is fifteen plus white. The reasons for this is found in the Specification, page 9, line 21 to page 10, line 2, because this is the maximum number of tone levels perceptible by the HVS. the applied portion of '769 uses the formula $k/2^B$, where k is the maximum possible gray level and B is the number of bits chosen. The Examiner is correct that if $B = 4$, $2^4 = 16$, however, this has nothing to do with selecting the maximum number of tone levels to be fifteen levels of gray plus white based on the HVS: if $B \neq 4$, some other number of tone levels will be used, and '769 is silent as to how B is selected, and states that B may be 4 to 12, col. 2, lines 37-38. Claim 6 is therefor allowable over the applied art, because the applied art does not teach or suggest specifically setting the number of tone levels to fifteen levels

of gray plus white.

Claim 7 is allowable with its allowable parent claim.

Claim 8 is allowable for the reasons set forth in connection with claim 1, and because the limitation of preserving the original dot amplitude has been added, as described in the Specification, page 8, lines 2-10. As noted in the discussion of the invention and the applied art, where the halftoned image is de-screened, the original dot density, treated as a signal amplitude, is not preserved. Applicant's method of the invention, using multi-step threshold reading of the original image allows the original dot amplitude to be preserved. This is neither taught nor suggested by either applied reference, nor by a combination thereof: '769 does not use a multi-step process; '032 uses a multi-step process which averages the density in a sub-cell. Claim 8 is allowable over the prior art of record.

Claim 9 is allowable for the reasons set forth in connection with claim 6.

Claims 10-12 are allowable with their allowable parent claim(s).

New claim 13 includes the limitations of claim 8 and an additional limitation which requires the setting of a multi-level threshold. This feature of the invention is described in the Specification, beginning on page 7, and is shown in Figs 1-4. There is no teaching nor suggestion of applying threshold values to an existing halftone image to generate a second generation halftone image. Claim 13 is therefore allowable over the cited art.

Claims 14-17 are allowable for the reasons set forth in connection with claims 9-12.

In light of the foregoing amendment and remarks, the Examiner is respectfully

requested to reconsider the rejections and objections stated in the Office action, and pass the application to allowance. If the Examiner has any questions regarding the amendment or remarks, the Examiner is invited to contact the undersigned.

Provisional Request for Extension of time in Which to Respond

Should this response be deemed to be untimely, Applicants hereby request an extension of time under 37 C.F.R. § 1.136. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any over-payment to Account No. 22-0258.

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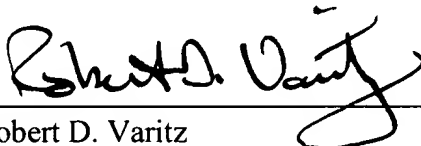
Respectfully Submitted,

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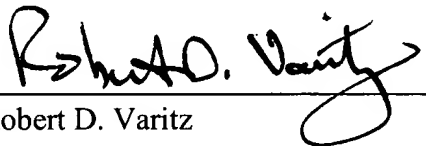
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